The Lake Tecumseh Weir Project

Lake Tecumseh and Back Bay in Virginia Beach, VA are important resources for both human and natural communities. They provide boating, fishing, and other recreational opportunities for outdoor enthusiasts and homeowners as well as important habitat for fish and other flora and fauna. However, increases in suspended sediment levels, erosion, and other issues created by the Asheville Bridge Canal put both resources in grave danger and left them in an unbalanced state. In response, the US Fish and Wildlife Service proposed the placement of a weir between the lake and the canal. This project, known as the Lake Tecumseh Weir Project, has been successful in controlling the flow of suspended sediments to Back Bay, stabilizing water levels in Lake Tecumseh, and providing better habitat for various fauna, especially migratory waterfowl.

Historically, Lake Tecumseh was open to the Atlantic Ocean; however, a hurricane closed off the opening in the late 1789 and the lake gradually lost its salinity (Smith, personal communication). It is roughly 500 meters from the ocean and covers 261 acres with an average depth of only two feet. The lake originally supported a variety of submerged aquatic vegetation (SAV) that provided an ample food source for fish, aquatic invertebrates, and waterfowl. Wetlands cover 104 acres surrounding Lake Tecumseh; 63% of these wetlands are wooded or scrub vegetation and 37% are herbaceous marsh (US Fish and Wildlife Service 2010). Back Bay National Wildlife Refuge, founded in 1938, contains 9200 acres of important wetland and barrier island habitat a few miles south of Lake Tecumseh. The bay is the northernmost part of the Albemarle Sound, which extends south to the outer banks of North Carolina and meets the Atlantic Ocean at the Oregon Inlet, some 70 miles to the south. Habitats within the refuge include barrier islands, woodlands, beaches, dunes, and freshwater marshes on islands within the bay. These habitats play a key role in the winter migration of various bird species. Visitation by tundra swans, geese, and various duck species peaks in December and January. Back Bay also provides an

important home for threatened and endangered species including loggerhead sea turtles, piping plover, brown pelican, and bald eagles. Both bodies of water lie within the Princess Anne County watershed, covering 130,000 acres and rising no more than 20 feet above sea level (Branch of River Basin Studies, 1958).

In the 1950s construction of a canal connecting Lake Tecumseh to Back Bay was proposed. A study by the Bureau of Sport Fisheries and Wildlife (1958) warned that these canals would increase suspended sediment in Back Bay, negatively affecting fish and wildlife and degrading the habitat's productivity. The construction project was stalled temporarily, but was completed in the 1960s, this time with the inclusion of a stone weir to help prevent sediment flow. The original weir, not much more than a pile of rocks and concrete, did not last long however, and was removed in the 1970s due to flooding complaints (Harper 2012; Smith, personal communication). An engineering study was completed in 1967 (Langley et al) which found that drainages leading into Back Bay were increasing both the salinity and amount of suspended sediment in the water. Further studies were completed in 2000 (Henley et al) and 2009 (Cook et al) which verified the increase in suspended sediment draining into Back Bay and the degradation of habitat and food chains. Lake Tecumseh's water levels have fluctuated dramatically since the completion of the canal, draining completely in winter months and during major storm events. The fluctuation of water levels and increased regular turbulence of the lake waters has increased bank erosion as well as turbidity. During these major drainage events, all of the added sediment makes its way to Back Bay, inhibiting sunlight used by SAV. These events have also lead to higher fish mortality due to lower water levels and increased turbidity which can clog gills. The aftermath of a storm event in 2008 left an estimated 150 white perch dead on the shores of Lake Tecumseh (Cook et al 2009). Ultimately, the canal created three major issues: increases in suspended sediment moving from Lake Tecumseh to Back Bay, highly variable water levels in the lake, and increased erosion along the lakeshore.

In response to this, the US Fish and Wildlife Service proposed the construction of two weirs along the southern extent of Lake Tecumseh, one at the entrance to the Asheville Bridge Canal and one a few hundred feet to the west (figure 1). A weir is a barrier placed in a body of water to alter flow regimes. Unlike a dam, water is intended to flow freely over the weir when necessary. The weirs would impede the transfer of suspended sediment between the lake and canal, as well as maintain a base water level throughout the year, effectively eliminating complete drainage. The original efforts were halted due to public outcry and fear that the weirs would inhibit recreational activity, particularly boating, as well as increase flooding in surrounding areas. In response, Will Smith, the lead biologist on the project, began an extensive public relations campaign. He wrote letters to waterfront owners, attended community meetings, personally responded to each inquiry, and provided pictures for those who could not visit the site personally (Smith, personal communication). A boat portage was proposed in addition to the placement of the two weirs, allowing boaters to move freely between the lake and canal. In response to fears of flooding, he pointed to a study completed in 2004 which determined that weirs would likely have little effect on flood events (Keaton 2004). The key factors in garnering public support included full disclosure, frequent communication, sincerity, and supporting scientific data (Smith, personal communication).

Figure 1. Proposed placement of weirs in Lake Tecumsah, VA. (Source: USFWS)

After over a year of hard work, the US Fish and Wildlife Service decided they had enough support to attempt the project again and started construction in September 2010. The completion of the project required about $250,000 in funds. Of this, $45,000 went to engineering design and surveys, while the remaining $205,000 went to construction, with $70,000 of that allocated for the boat portage. Funding came primarily from the US Fish and Wildlife Service. Additional supporters of the project

included the Back Bay Restoration Foundation, Hampton Roads Sanitation District, City of Virginia Beach, NAS Oceana, Friends of Back Bay, and Virginia Department of Game and Inland Fisheries. Most of these organizations wrote letters in support of the project or provided additional studies and scientific background. The Hampton Roads Sanitation District allowed use of their land on the northwest side of the lake for material transportation and staging. Construction was contracted out to CMI Sheet Piling with some additional help from the AmeriCorps National Civilian Community Corps.

Construction involved three main stages: preparing the berm on the southern shore of the lake, placing weirs to the east and west of this, and constructing the boat portage between them. The berm separating the lake and canal had experienced extreme erosion during periods of dramatic lake fluctuation. Originally steep, narrow, and tall, the berm was leveled to increase its surface area and lessen the likelihood of erosion. Coir fiber logs were staked into the surrounding area beforehand to hold the reshaped berm in place while native plants were allowed time to develop root systems and prevent future erosion. Grass matting was planted after the flattening of the berm and native vegetation was gathered and spread as well. After this work, the weirs were put in place. The materials used for weir construction consisted of ShoreGuard® vinyl sheet piling to minimize degradation from UV rays and the salinity of water as well as leaking of chemicals that would likely occur if concrete or steel and treated wood were used. The main weir spanned 40ft across the former canal inlet, overlapping each bank 15 extra feet to minimize seepage and erosion (CMI Sheet Piling 2013). The boat portage uses a solar-powered winch to transport boats from Lake Tecumseh to

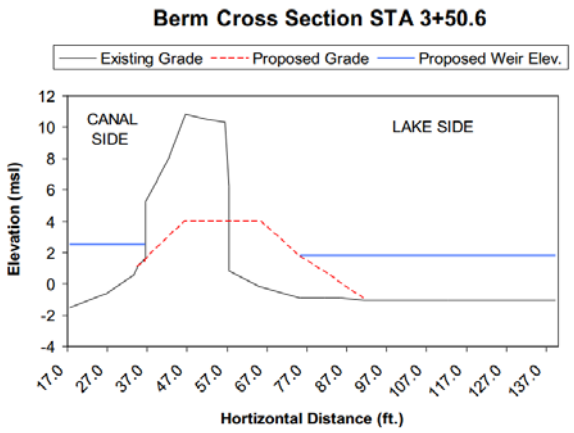

Figure 2. Original and proposed grades of the berm on the south side of Lake Tecumsah. (Source: USFWS)

the Asheville Bridge Canal, a five minute journey that ensures ease of access for recreation users. The project was finished on February 7, 2011, taking just over five months.

Monitoring of the site has occurred on a yearly basis, beginning with two years of pre-weir conditions and continuing for five years after completion. This will be used to measure the benefits of the weir as well as to ensure no undesired effects are occurring. The monitoring has a three-fold focus, including water quality and levels, fish surveys, and general wetland monitoring accounting for SAV and other vegetation. Prior to weir construction, water levels would fluctuate drastically in the lake, its depth shifting 3.5 feet, from one foot below sea level to 2.5 feet above sea level. The lowest levels generally occurred between September and March. In the two years since the completion of the weirs, water levels have fluctuated only about a foot, between one and two feet above sea level (figure 3). The weir height extends to one foot above sea level and minimizes extreme water fluctuation, prevents complete drainage, and reduces the flow of sediment to Back Bay. These effects will also be beneficial to boaters, allowing recreation use throughout the year instead of just the spring and summer.

To conduct fish monitoring, the US Fish and Wildlife Service and the Virginia Department of Game and Inland Fisheries used an electroshock boat to survey fish in the lake. They visited three

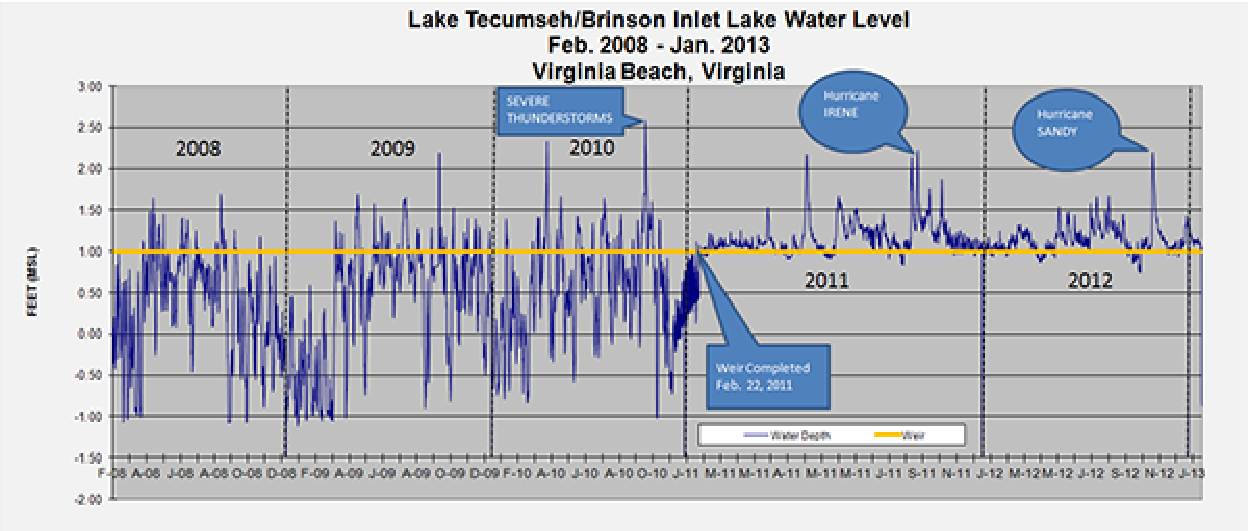

Figure 3. Water fluctuation in Lake Tecumsah from 2008-2013. Note the yellow line representing the weir level and the dramatic shift upon weir completion in 2011. (Source: USFWS)

locations around the lake for 10 minute increments each and recorded their findings. Surveys were completed in both the fall and spring to demonstrate breeding and retained populations. Pre-weir surveys counted 155 fish of 14 species in September 2008 and 173 fish from 15 species in May 2009. In 2011, the year the weir was completed, 218 fish from 18 species were collected in June and 220 fish from 19 species were collected in September. One year later, September 2012, showed even more dramatic results, with 328 fish from 24 species. Since the completion of the weir, 13 new species of fish, as well as blue crab, were found in the lake, a nearly 75% increase from the 19 species in the original surveys, while the total number of fish collected has doubled. This will also likely create better fishing opportunities in a lake that for the past few decades has not been especially productive for fisherman (Smith 2013b).

For wetlands and vegetation monitoring, eight 10-meter square tree plots and twenty-four 1-meter square herbaceous plots were surveyed. Aquatic vegetation was measured using twenty-six 1-meter square plots. The 2012 monitoring report (Smith 2013a) found little change in tree mortality and an increase in herbaceous plant cover after the completion of the weir. Submerged aquatic vegetation was measured to cover an estimated 69% of the lake, based on averages from each plot. Prior to the weir, no significant submerged aquatic vegetation was observed, likely due to the seasonal draining of the lake. This increase in SAV has provided an adequate food source for ducks and other waterfowl, which were a winter presence at the lake once again (Harper 2012). So far, all effects of the restoration have been beneficial and expected. Furthermore, an average of 2000 tons of sediment is being prevented from flowing into Back Bay annually, improving SAV resources for migrating waterfowl (Tihansky and Smith, 2012).

The Lake Tecumseh Weir Project was completed with clear goals and expected outcomes. Problems were well understood from the beginning, including high suspended sediment levels in Lake

Tecumseh and Back Bay, drastically fluctuating water levels in the lake, and heavy erosion. Constructing the weirs attained the desired effects of reducing sediment flow, stabilizing water levels, and minimizing erosion, thereby improving the habitat for a variety of species as well as recreationists. Continued management of this project is expected to be low, consisting mostly of annual maintenance of the boat portage (Smith, personal communication).

With the benefits of increased SAV, more productive habitat for waterfowl, and increased recreation opportunities for humans, it is clear that this restoration project has achieved its desired goals and will provide a good model for other restorationists to follow. Perhaps the biggest lesson that can be taken from this project is the necessity of community involvement. Originally derailed by misinformation, the success of this restoration relied on the support of the public, and it provides an excellent illustration of the importance of civic engagement in restoration. Cultural and ecological restoration certainly go hand-in-hand.

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